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Tunnel Magnetoresistance in Magnetic Tunnel Junctions with Embedded Nanoparticles

Useinov A., Useinov N., Ye L., Wu T., Lai C.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 1965-2012 IEEE. In this paper, we attempt the theoretical modeling of the magnetic tunnel junctions with embedded magnetic and nonmagnetic nanoparticles (NPs). A few abnormal tunnel magnetoresistance (TMR) effects, observed in related experiments, can be easily simulated within our model: we found, that the suppressed TMR magnitudes and the TMR sign-reversing effect at small voltages are related to the electron momentum states of the NP located inside the insulating layer. All these TMR behaviors can be explained within the tunneling model, where NP is simulated as a quantum well (QW). The coherent double barrier tunneling is dominating over the single barrier one. The origin of the TMR suppression is the quantized angle transparency for spin polarized electrons being in one of the lowest QW states. The phenomenon was classified as the quantized conductance regime due to restricted geometry.

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Keywords

ballistic transport, Magnetic tunnel junctions, Tunnel magnetoresistance